High Power Components for Advanced LIGO

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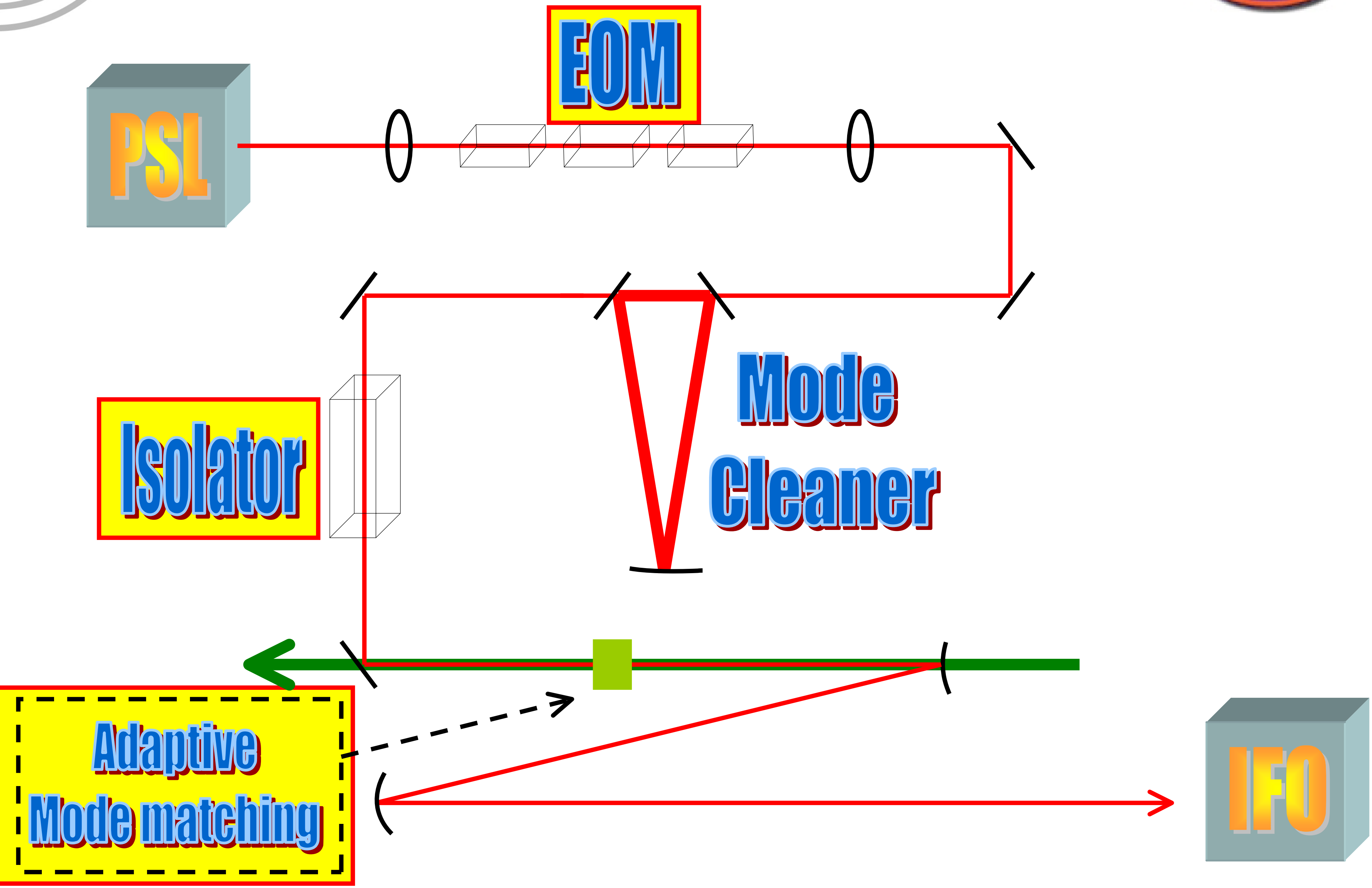
Input Optics



EOM

Objectives:

- Modulation of m>0.1 at 180MHz ☑
- Beam Distortion < 1% (☑at 45W)
- Total losses < 2% (☑at 45W)

} Each EOM

- RFAM-Stability ?
  - In Band (direct coupling)
  - Out of Band (Offset drifts, …)

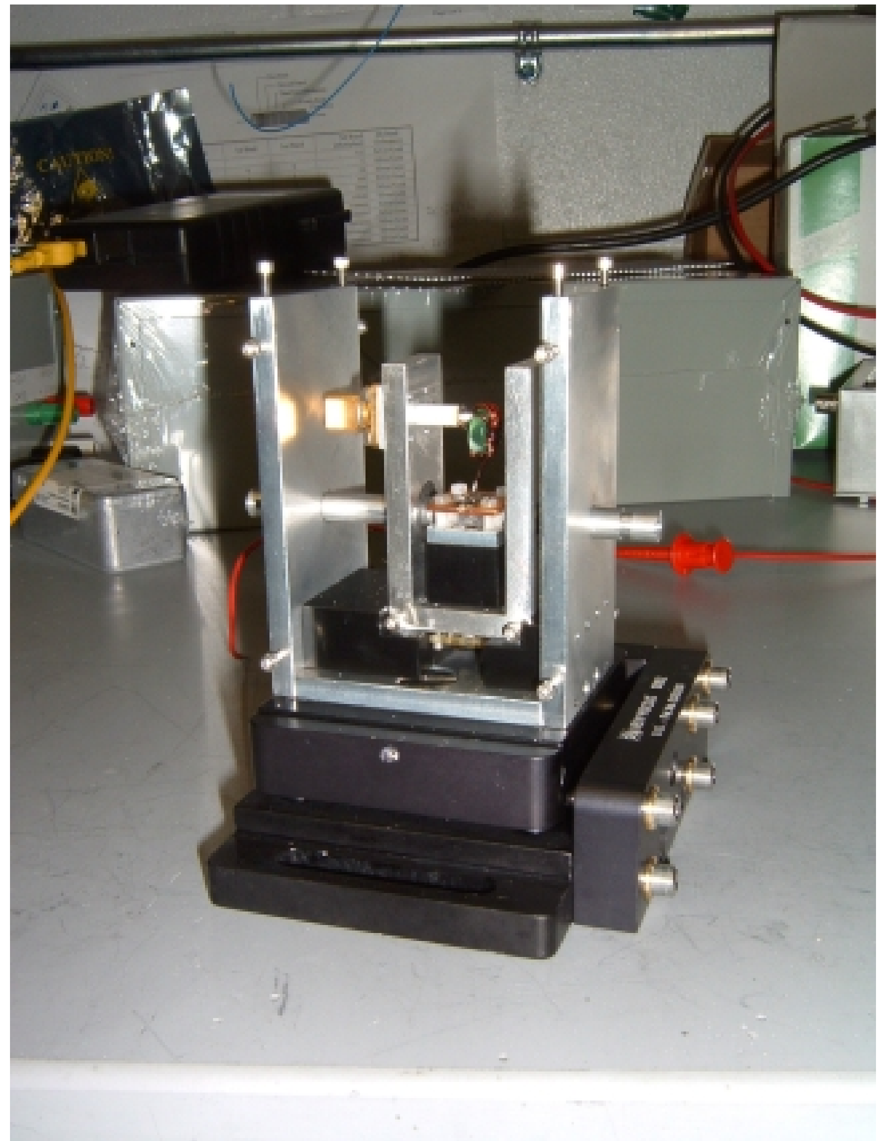
at 200W laser input power.

Disclaimer:
Objectives/Requirements subject to change !

EOM

Stabilization of EOM:
- Temperature stabilized
- Brewster polarizer
- RF-shield
- Thermal shield

Stabilization of Input field:
- Polarization
- Pointing
- Intensity



EOM

Summary EOM:

- RTA & RTP work at 45W laser power
- Stability measurements just started

Outlook:

- need 100W laser for more tests

Faraday Isolator

Objectives:

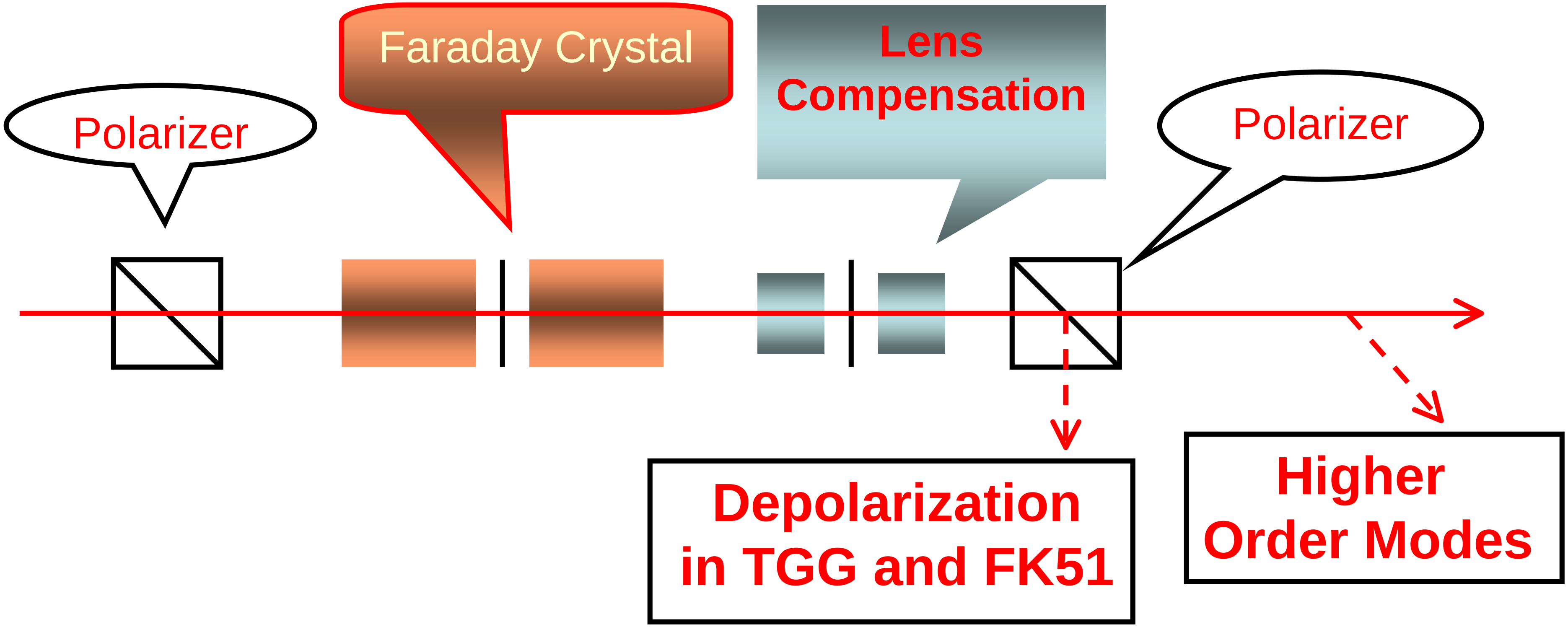
- Isolation ratio (>30dB)
- Beam Distortion < 3%
- Total losses < 6%

at 20 and 135W laser power.

Disclaimer:

Objectives/Requirements subject to change !

Faraday Isolator

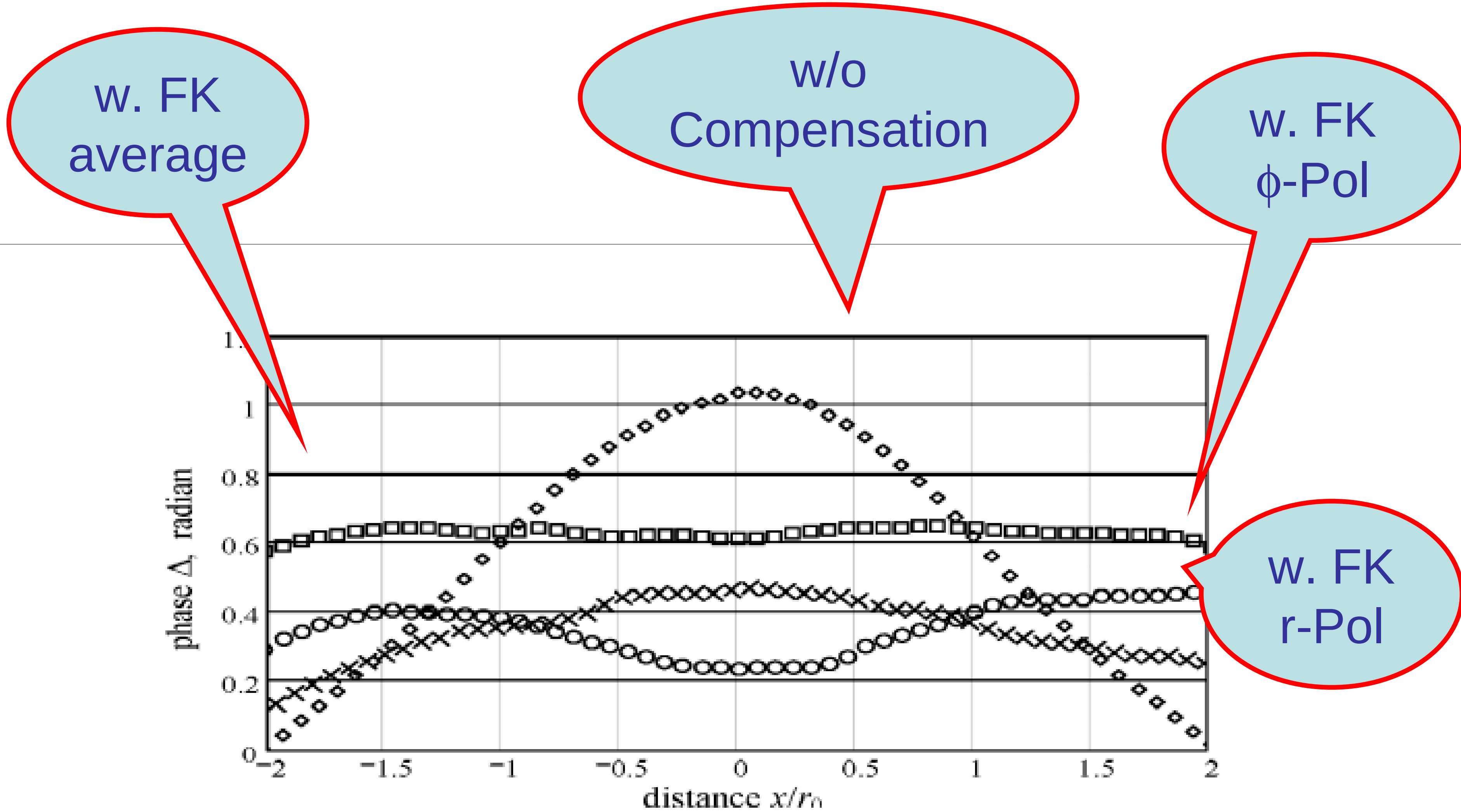


Compensator	1pcs FK51	2pcs FK51	Crystal
Losses 125W	~5%	AR-coating	AR-coating
Comment	Depolarization	Distance ?	

See: *Compensation of thermally induced modal distortions in FI*, upcoming paper

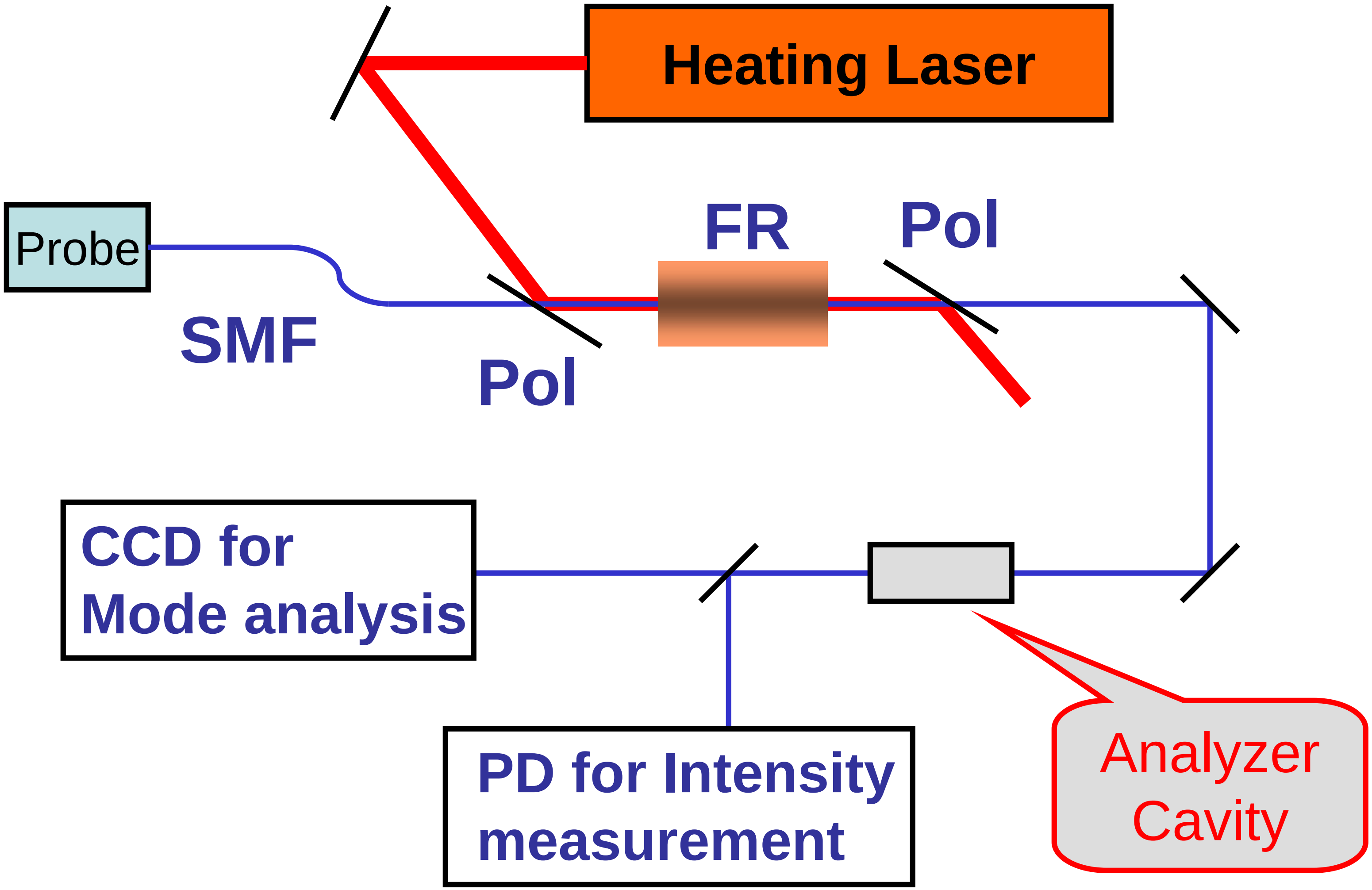
Depolarization

P (heating Laser) = 38W   only one piece FK51



See: *Compensation of thermally induced modal distortions in FI*, upcoming paper

Faraday Isolator

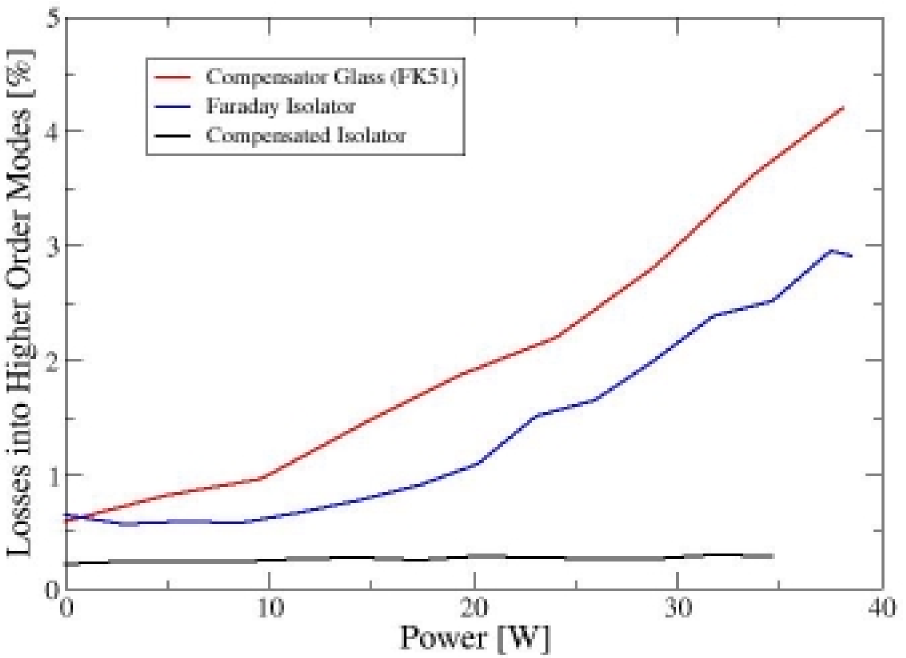


Data: Intensity in different Cavity Eigenmodes

Faraday Isolator

Experimental Results:

- No thermal lensing up to 35W laser power
- Low losses
- Isolation > 40dB (with Comp. outside Isolator)



Options:

1. Two glass compensators (FK51) with wave plate
2. Crystal Compensator (YLF)

Faraday Isolator

Outlook (for FK51 compensated Isolator):
- waiting for 100W laser at LLO (delayed again …)
- measure thermal distortion & depolarization at 100W
- measure isolation ratio at 100W

Start experiments with YLF-crystal based compensation at UF

Adaptive Mode Matching

Objectives:

- Change the mode matching between MC and IFO without breaking the vacuum
- Dynamic Range ?   Power: 20-130W ?
  (Change IFO Eigenmode by ~20%)
- No moving parts
- No additional beam distortion

Adaptive Mode matching

Idea: Create Thermal lens with a heating beam

Material:

- **absorb heating beam**
- **transmit main laser**

Heating beam:

- **at least factor 2 larger than main laser**

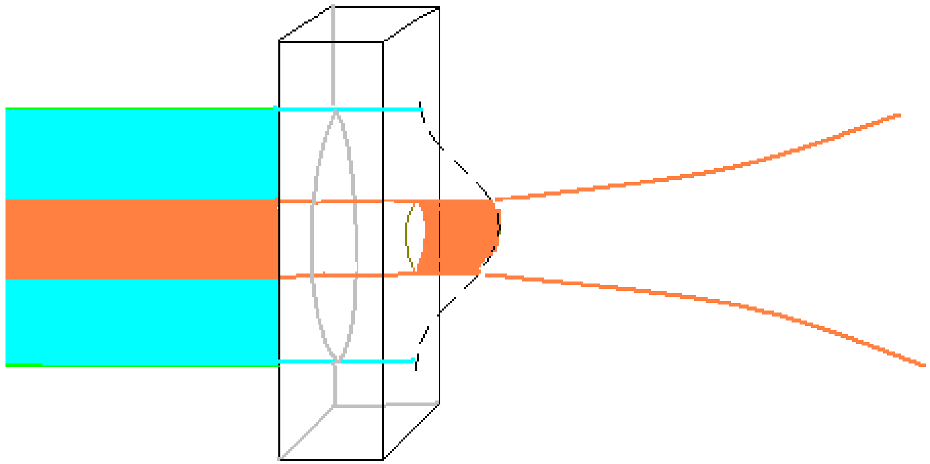


FIG. 4 : Thermal lensing

Adaptive Mode matching

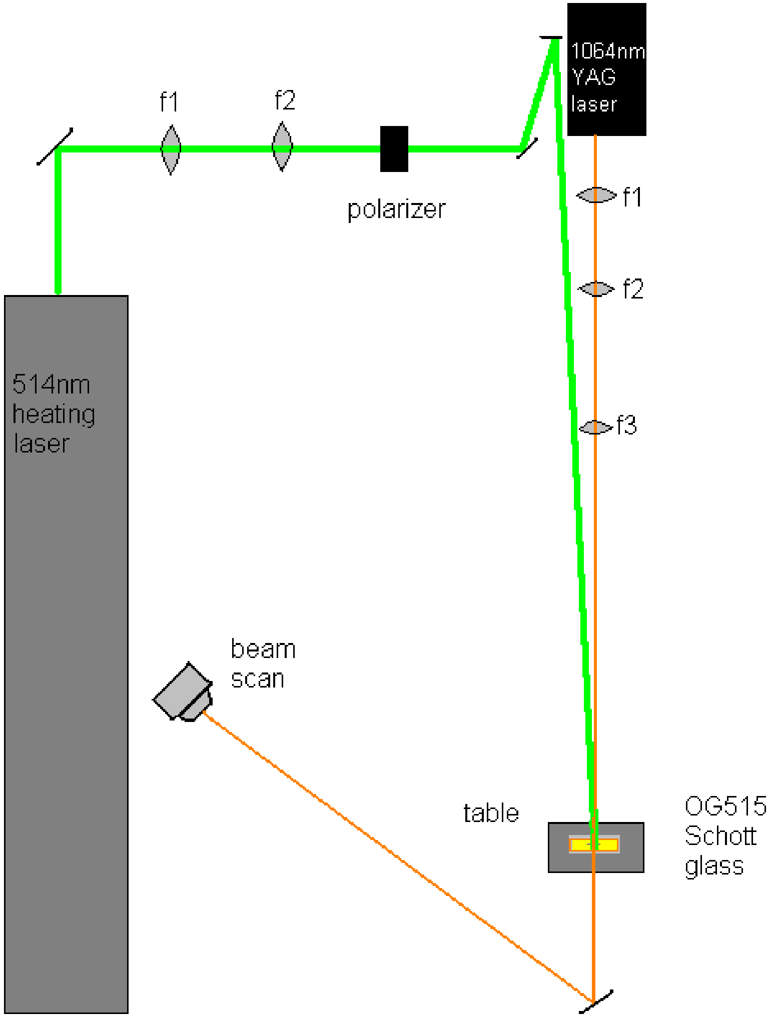


FIG. 8: Setup for OG515 Schott glass experiment

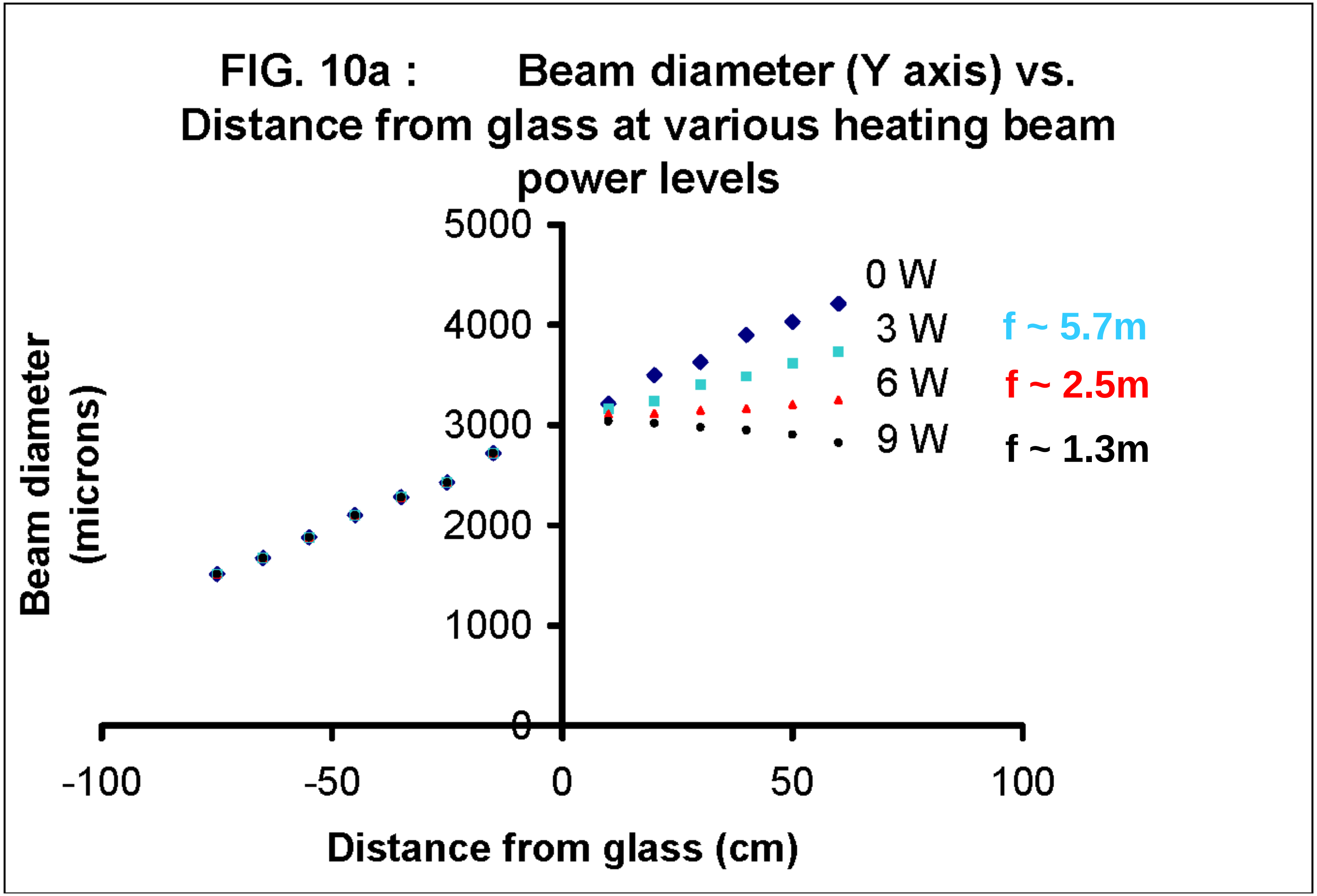
Heating Beam:
Argon Laser (30W)

Probe Laser:
NPRO

Thermal Lens Material:
OG515
- absorbs green
- transmits IR

Diagnostic: Beam Scan

Adaptive Mode matching



Adaptive Mode matching

Outlook:

- Experiments have to go beyond proof of principle
- Need to derive requirements on dynamic range
- Design experiment for optimized performance
- Work on theory

High Power Components

Summary:

- All Components look good so far, no major technological problems (yet)

Outlook / Problems:

- Need to test with more laser power
- **Production ?**

  (because of # of components needed)

Faraday Isolator

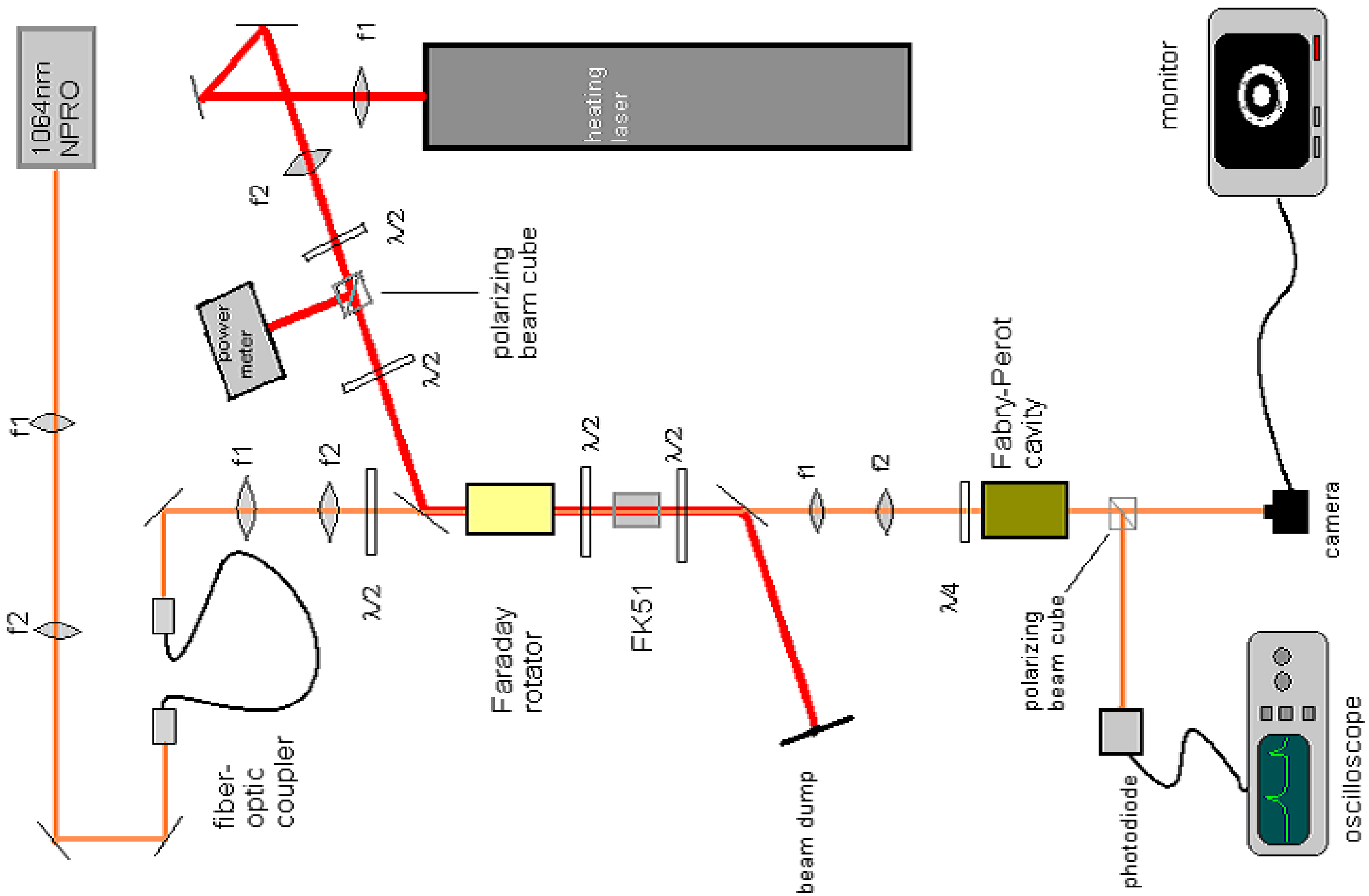


FIG.5 : Setup for FK51 experiment